CLAIMS

We claim:

1. An electroslag remelting method for producing a metallic ingot, the method comprising:

disposing slag within a withdrawal mold comprising a mold wall and an electrically conductive member disposed through the mold wall;

contacting the slag with a consumable electrode;

heating the slag by conducting an electrical current through the consumable electrode into the slag, thereby melting at least a portion of the consumable electrode in contact with the slag;

collecting at least a fraction of the melted portion of the consumable electrode in the withdrawal mold to form the ingot; and

conducting at least a portion of the electrical current from the slag through the electrically conductive member.

2. The method of claim 1, wherein the ingot has a diameter greater than 16 inches.

3. The method of claim 1, further comprising cooling the ingot by contacting the ingot with a fluid within a gap between the ingot and the wall of the withdrawal mold.

4. The method of claim 3, wherein the fluid is at least one of a gas and a liquid.

5. The method of claim 3, wherein the fluid is at least one material selected from the group consisting of water, helium, argon, nitrogen, steam and air.

6. The method of claim 1, wherein the consumable electrode consists essentially of an alloy selected from the group consisting of an iron-base alloy, a nickel-base alloy and a cobalt-base alloy.

7. The method of claim 1 wherein the consumable electrode comprises, in weight percentages:

0 to 0.08 carbon;

0 to 0.35 manganese;

0 to 0.35 silicon;

0 to 0.015 sulfur;

0 to 0.015 phosphorus;

17.0 to 21.0 chromium;

50.0 to 55.0 nickel;

0 to 1.0 cobalt

2.8 to 3.3 molybdenum;

0.65 to 1.15 titanium;

0.20 to 0.8 aluminum;

0 to 0.006 boron;

at least one of niobium and tantalum, wherein the sum of the weights of niobium and tantalum is 5.0 to 5.5; and

iron.

8. An electroslag remelting method for producing a metallic ingot, the method comprising:

disposing slag within a withdrawal mold comprising a mold wall;

contacting the slag with a consumable electrode;

heating the slag by conducting an electrical current through the slag, thereby melting at least a portion of the consumable electrode in contact with the slag, wherein at least a fraction of the electrical current introduced into the slag passes through portion of the mold wall and into the slag; and

collecting at least a fraction of the melted portion of the consumable electrode in the withdrawal mold to form the ingot.

9. The method of claim 8, wherein the ingot has a diameter greater than 16 inches.

10. The method of claim 8, further comprising cooling the ingot by contacting the ingot with a fluid within a gap between the ingot and the mold wall of the withdrawal mold.

11. The method of claim 10, wherein the fluid is at least one of a gas and a liquid.

12. The method of claim 10, wherein the fluid is at least one material selected from the group consisting of water, helium, argon, nitrogen, steam and air.

13. The method of claim 8, wherein the consumable electrode consists essentially of an alloy selected from the group consisting of an iron-base alloy, a nickel-base alloy and a cobalt-base alloy.

14. The method of claim 8, wherein the consumable electrode comprises, in weight percentages:

0 to 0.08 carbon;

0 to 0.35 manganese;

0 to 0.35 silicon;

0 to 0.015 sulfur;

0 to 0.015 phosphorus;

17.0 to 21.0 chromium;

50.0 to 55.0 nickel;

0 to 1.0 cobalt

2.8 to 3.3 molybdenum;

0.65 to 1.15 titanium;

0.20 to 0.8 aluminum;

0 to 0.006 boron;

at least one of niobium and tantalum, wherein the sum of the weights of niobium and tantalum is 5.0 to 5.5; and

iron.

15. The method of claim 8, wherein the mold wall includes at least a first portion electrically isolated from a second portion, and wherein heating the slag comprises conducting the at least a fraction of the electrical current into the slag through the first portion of the mold wall and not through the second portion of the mold wall.

16. The method of claim 15, further comprising:

conducting at least a fraction of the electrical current away from the slag through the second portion of the mold wall.

17. An electroslag remelting method for producing a metallic ingot, the method comprising:

disposing a slag within a withdrawal mold comprising a mold wall and an electrically conductive member disposed through the mold wall;

contacting the slag with a consumable electrode;

heating the slag by conducting an electrical current into the slag, thereby melting at least a portion of the consumable electrode in contact with the slag,

wherein at least a fraction of the electrical current passes through a region of the mold wall and into the slag;

collecting at least a fraction of the melted portion of the consumable electrode in the withdrawal mold to form the ingot; and

conducting at least a fraction of the electrical current from the slag through the electrically conductive member.

18. The method of claim 17, further comprising cooling the ingot by contacting the ingot with a fluid within a gap between the ingot and the mold wall of the withdrawal mold.

19. The method of claim 18, wherein the fluid is at least one of a gas and a liquid.

20. The method of claim 18, wherein the fluid is at least one material selected from the group consisting of water, helium, argon, nitrogen, steam and air.

21. The method of claim 17, wherein the consumable electrode consists essentially of an alloy selected from the group consisting of an iron-base alloy, a nickel-base alloy and a cobalt-base alloy.

22. The method of claim 17, wherein the consumable electrode comprises, in weight percentages:

0 to 0.08 carbon;

0 to 0.35 manganese;

0 to 0.35 silicon;

0 to 0.015 sulfur;

0 to 0.015 phosphorus;

17.0 to 21.0 chromium;

50.0 to 55.0 nickel;

0 to 1.0 cobalt

2.8 to 3.3 molybdenum;

0.65 to 1.15 titanium;

0.20 to 0.8 aluminum;

0 to 0.006 boron;

at least one of niobium and tantalum, wherein the sum of the weights of niobium and tantalum is 5.0 to 5.5; and

iron.

23. A metallic ingot made using any of the methods of claims 1, 8 and 17.

24. An electroslag remelting apparatus comprising:

a power source;

an open-bottomed mold including a mold wall and an electrically conductive member disposed through the mold wall, wherein the electrically conductive member is in electrical communication with the power source; and

an electrode feed mechanism adapted to advance an electrode toward the open-bottomed mold.

25. The electroslag remelting apparatus of claim 24, wherein the electrically conductive member comprises at least one of graphite and a refractory metal.

26. The electroslag remelting apparatus of claim 24, wherein the mold has an internal wall including an ingot cooling mechanism.

27. The electroslag remelting apparatus of claim 24, wherein the mold has an internal wall including at least one fluid dispensing nozzle dispensing at least one of a gas and a liquid.

28. The electroslag remelting apparatus of claim 24, wherein the mold has an internal wall including a plurality of fluid dispensing nozzles positioned around a bottom region of the mold.

29. An electroslag remelting apparatus comprising:

a power source;

an open-bottomed mold including a mold wall, wherein at least a portion of the mold wall is in electrical communication with the power source; and

an electrode feed mechanism adapted to advance an electrode toward the open-bottomed mold.

30. The electroslag remelting apparatus of claim 29, wherein the mold further includes an electrically conductive member disposed through the mold wall and in electrical communication with the source of electrical power.

31. The electroslag remelting apparatus of claim 29, wherein the mold wall includes a first portion in electrical communication with the power source and a second portion that is electrically insulated from the first portion and not in electrical communication with the power source.

32. The electroslag remelting apparatus any of claims 29 and 30, wherein the mold has an internal wall including an ingot cooling mechanism.

33. The electroslag remelting apparatus of any of claims 29 and 30, wherein the mold has an internal wall including at least one fluid dispensing nozzle dispensing at least one of a gas and a liquid.

34. The electroslag remelting apparatus of any of claim 29 and 30, wherein the old has an internal wall including a plurality of fluid dispensing nozzles positioned around a bottom region of the mold.